DOCUMENT RESUME

ED 228 601 CG 016 628

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TITLE An Examination of Logical vs. Chronological Relation in Explanations of Meaningfulness.
PUB DATE Aug 82
NOTE 18p.; Paper presented at the Annual Convention of the American Psychological Association (90th, Washington, DC, August 23-27, 1982).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Associative Learning; *Cognitive Style; College Students; Higher Education; Individual Differences; *Learning Theories; *Logical Thinking; *Recall (Psychology); Self Concept
IDENTIFIERS Covert Rehearsal; *Meaningfulness

ABSTRACT

Logical learning theory stresses that learning occurs through logical relation. Materials most "related" to the cognitive organization of the learner are most readily retained. To test whether the "chronological" constructs of covert rehearsal and familiarity could account for the learning attributed to "logical" relatedness, 56 college students who had previously shown a recall superiority for liked items were presented 28 consonant-vowel-consonant trigrams (of equal familiarity) such that subsequent rehearsal could be systematically controlled with interpolated tasks before attempted recall. Results showed that the recall of the liked items was independent of covert rehearsal. A significant decrease in overall recall occurred as rehearsal was increasingly limited but the reliance on the items considered the more meaningful (the like items) was significantly increased. This finding supports a separate, logical form of meaningfulness, and questions some axioms of learning and education. (JAC)

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ED228601

An Examination of Logical vs. Chronological Relation in Explanations of Meaningfulness

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Running Head: Covert Rehearsal and Meaningfulness

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ABSTRACT

The purpose of the present study was to test whether the "chronological" constructs of covert rehearsal and familiarity could account for the learning attributed to "logical" relatedness. Subjects who had previously shown a recall superiority for liked items were presented CVC trigrams (of equal familiarity) such that subsequent rehearsal could be systematically controlled via interpolated tasks before attempted recall. A significant decrease in overall recall occurred as rehearsal was increasingly limited, but the reliance on the items considered the more meaningful (the liked items) was significantly increased. This finding supports a separate, logical form of meaningfulness, and questions some axioms of learning and education.

An Examination of Logical vs. Chronological Relation in Explanations of Meaningfulness

Logical learning theory stresses that learning occurs through logical relation (Rychlak, 1981). The cognitive organization of the learner and the organization of the information to be learned are analogous to the premises of a syllogism. Their relation (the logical "conclusion") is central to learning. For example, meaningful information is that which is most "related" to cognitive schema.

An important characteristic of this approach is that logical relation is independent of chronological relation. Logicians have long held that logical conclusion does not require some period of time (Whitrow, 1961). The relation between two premises occurs simultaneously with their presentation. As applied to learning, this implied that the learning of meaningful information occurs simultaneously with exposure, i.e., in the present and in one trial. Although a number of mainstream models account for one-trial learning, few (if any) explain meaningfulness without resorting to some manipulation of information across time (Slife, 1981). That is, meaningful items are those with the most frequency of exposure, familiarity, or amount of past experience--all of which require time.

Advocates of logical learning theory have sought to show that explanations which use chronological relation are insufficient to explain meaningfulness. Repeated exposure, familiarity, past experience, etc., are indirect influences only, permitting logical relation between learner and information to occur. To show this, a typical paradigm has been to equate materials to be learned for previous experience and show that materials

"related" to the cognitive organization of the learner are most readily retained.

"Relatedness" has been determined by several means. For example, subjects with "masculine" personality profiles have been shown to learn masculine-type items more readily than feminine-type items, despite the fact that all items were equally familiar (Rychlak et al., 1973). In other studies, a more global type of "relatedness" has been investigated. Subjects with positive self-concepts learn items considered "positive" (liked, pleasant) more readily than "negative" items even though all items were equated for frequency of exposure and past experience (as well as word quality, ease of learnability, etc.) (see Rychlak, 1977, ch. 9 & 10; 1981). Similarly, subjects with negative self-concepts have been shown to learn negatively charged items more readily than positive items with the same types of controls for chronological accounts (August et al., 1975; Rychlak et al., 1971).

Unfortunately, as rigorous as these controls have been, no controls for in-experiment covert rehearsal of the liked items have been instituted. This is a major oversight not only because covert rehearsal could account for the findings attributed to "logical relation," but also because covert rehearsal is itself a frequency of exposure, across time, explanation of learning. Consequently, the purpose of the present study was to test whether the "chronological" construct of covert rehearsal could account for the learning attributed to the "logical" constructs of logical learning theory.

Using subjects who have repeatedly shown a recall superiority for liked materials, equally familiar items were presented for rating (like or dislike) such that subsequent rehearsal could be systematically limited

before attempted recall. Because it is virtually impossible to reliably obviate rehearsal altogether, four information reduction tasks were employed as interpolated tasks in order to limit rehearsal. If such a systematic limiting resulted in a corresponding diminution of the recall difference between liked and disliked items, this finding would support a covert rehearsal explanation of the typical superiority found in the recall of liked materials. If, on the other hand, a significant diminishment of rehearsal did not attenuate the superiority of the liked material in recall, then the logical relation explanation would be supported.

METHOD

Subjects. 28 female and 28 male introductory psychology students served as subjects. This population of college students has been shown repeatedly to learn liked items more readily than disliked items across many different learning materials (see Rychlak, 1977).

Materials presented. Each subject was presented twenty-eight consonant-vowel-consonant trigrams, the entire list of those items at one level (the 50% level) of "association value" as normalized by Archer (1960). Although Archer's norms are over 20 years old, research has shown the recall superiority of liked trigrams in idiographic and up-to-date ratings of familiarity and wordlikeness (e.g., Rychlak & Nguyen, 1979).

Interpolated tasks. Four information transformation tasks were employed as interpolated tasks in order to limit rehearsal. These were provided and tested by Posner and Rossman (1966) who showed that such tasks systematically interfere with covert rehearsal. The four tasks involved the following manipulations of two-digit numbers:

Reverse the sequence--Subjects wrote a pair of digits in the opposite order from their presentation. This transformation had the same input

and output information, thus reducing 0 bits of information.

Add the numbers--Subjects wrote the sum of the adjacent numbers. Input information was approximately 6.6 bits, while the sum contained only 3.8 bits resulting in a 2.8 bit reduction.

Categorize as high-low, even-odd--Subjects wrote "H" or "L" depending on whether the number was higher or lower than 50 and "E" or "O" depending on whether the number was even or odd. The input information was the same as in previous tasks, while the output was only 2 bits, yielding a 4.6 bit reduction.

Classify as "A" or "B"--Subjects recorded "A" if the number was high and even or low and odd. If, however, the number was high and odd or low and even the subject recorded a "B" yielding a 5.6 bit reduction in either case.

Random two-digit numbers were generated by computer and listed on separate sheets of paper. Twenty-eight such sheets, seven sheets per distractor task, were assembled in a random order for each subject so that each of the 28 trigrams presented had a separate distractor task sheet. At the top of every sheet were brief instructions indicating what the subject was to do with the numbers following (e.g., "reverse the sequence," "add the numbers").

Apparatus. Two pressure-sensitive Lucite switches labeled "like" and "dislike" were located in front of the subjects and connected to a clock (accurate to .1 msec) and a projector. The projector was used to project the trigram to be learned onto a screen directly in front of and at the eye level of the subject. The clock measured the time between item presentation and the initiation of the distractor task. Touching one of the switches advanced the projector to an opaque slide, thereby removing the item from view while the subject performed the distractor task. Thirty seconds from the rating,

a chime was sounded singaling the subject to record the trigram just presented in the space provided on the distractor sheet. Five seconds later the projector was automatically advanced, displaying the next trigram.

Procedure. Subjects were first familiarized with the apparatus, distractor tasks, and type of materials to be presented. Practice trigrams were presented and the four interpolated tasks were worked through until the automated procedure was completely understood.

Subjects were seated at a table and asked to fixate upon a dot on a screen in front of them. Each subject was instructed to press either switch ("like" or "dislike") with the index finger of the right hand. A dark spot at the midpoint between the switches indicated where the index finger was to rest prior to the rating of the item. With finger in resting position and eyes fixated on the dot, the trigram presentation was begun by the experimenter. The subject was instructed (and trained) to immediately press the appropriate switch once a decision had been made as to whether the trigram was liked or disliked. Pressing either switch advanced the projector to an opaque slide removing the trigram from view.

Immediately following switch selection, the subject proceeded to the distractor task by turning up the next page and beginning whichever information reduction task was indicated. While the subject performed the task for the 30 second period, the experimenter recorded the rating (like or dislike), and the time between item presentation and initiation of the distractor task. The performance of the subjects was carefully observed by the experimenter and found to be relatively error-free (i.e., error < 3%) across all tasks. Experimenters periodically urged each subject to perform the tasks as quickly and as accurately as possible.

At the end of the 30 second period, a chime automatically sounded cueing the subject to write down the trigram just presented and return his/her finger to the resting position between the rating switches. Five seconds after the chime, the projector advanced presenting the next trigram and repeating the procedure. The sequence of interpolated tasks and presentation of the trigrams were randomly ordered for each subject. Only two subjects gave identical ratings (either liked or disliked) to all those trigrams followed by a particular distractor task. These subjects were dropped from further participation in the experiment.

RESULTS

A 2 (sex) x 4 (interpolated task) x 2 (trigram rating) factorial analysis of variance was performed on the data. The last two factors were treated as within-subject conditions. The dependent variable was the proportion of correct recall, the denominator of the proportion being the number of trigrams rated a particular way (liked or disliked) on a particular task, and the numerator being the number of trigrams recalled in that rating category. No subject had less than 2 trigrams rated a particular way for each distractor task (the denominator). The overall proportion of trigrams in each rating category varied only slightly from half liked and half disliked for each task. The mean proportions of those trigrams rated liked in each of the distractor tasks were the following (as ordered from the least to the most interfering task): Task #1 = 49%, Task #2 = 52%, Task #3 = 48%, Task #4 = 51%. Because of the varying individual denominators, however, a linear (arcsin) transformation was performed to ensure that the assumptions underlying the analysis were met (Winer, 1971).

Significant main effects were found for two factors: trigram rating and interpolated task. (There were no significant main or interaction effects

involving the sex factor.) The main effect for task (F = 12.10, df = 3/162, p < .001) indicated that as more information was transformed, recall scores decreased. This supports the contention that rehearsal was systematically limited. The main effect for trigram rating (F = 10.17, df = 1/54, p < .001) showed that subjects obtained significantly higher recall scores on trigrams which they rated liked (M = .76) than those which they rated disliked (M = .65).

Rating appears to be a significant factor across all tasks (see figure 1), and especially so as the tasks involved more information reduction

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Figure 1 about here

(and rehearsal interference). However, the rating and task factors did not significantly interact. Inspection of figure 1 does suggest greater reliance on the liked materials as the distractor tasks demanded more "processing" capacity. A one-way analysis of variance conducted on the percentage of total recall accounted for by the liked materials (on each task and for each subject) bears out the significance of this increasing reliance (F = 5.15, df = 3/162, p < .01). In other words, as the ability to rehearse decreased, the subjects increased their reliance on those items rated liked in their recall.

In order to investigate the possibility that subjects took more time with (and possibly rehearsed more) the liked trigrams prior to the initiation of the interpolated task, the times between item presentation and task initiation were analyzed using the same statistical treatment described above (viz., a three-factor analysis of variance excluding the transformation). No significant differences were found. In fact, means were in the opposite direction for a rehearsal explanation (liked M = 2.2 seconds and disliked M = 2.4 seconds).

An identical analysis was also performed on the amount of completed interpolated task (viz., the quantity of two-digit numbers manipulated). As would be expected given the nature of the interpolated tasks, there was a main effect for task ($F = 14.40$, $df = 3/162$, $p < .001$). That is, more two-digit numbers were "reversed" than were "categorized A or B." More pertinently, however, no significant difference was found between those tasks which followed a liked trigram rating and those tasks which followed a disliked trigram rating, regardless of the type of information transformation performed, and no interaction reached significance.

DISCUSSION

Results show that the recall of the liked items was independent of covert rehearsal. First, the recall superiority of liked items was not decreased by the significant decrease in rehearsal and recall. Second, no indication of differential rehearsal was shown in the short period of time preceding the interpolated tasks. Third, subjects did not complete less of the interpolated tasks which followed liked items, providing no evidence for a retroactive interference explanation of the findings. Such findings support a logical learning theory explanation of the liked items' meaningfulness. The positive to positive (self-concept to materials) "logical relation" was powerful enough to occur in trigrams of equal familiarity. That is, recall of liked items was independent of not only rehearsal, but also familiarity or amount of past experience.

Because the trigrams were equated for familiarity on the basis of norms, one might suspect that those trigrams rated as liked were the more idiographically familiar to individual subjects. The lack of a significant two-factor interaction does not obviate this possibility in this experiment. Certainly,

the increasing reliance on liked items across tasks, albeit not significant for proportion of correct recall, would make an explanation based on idiographic familiarity improbable. That is, the idiographically familiar trigrams would consistently have to have been in the more difficult interpolated tasks, and the randomization of trigram presentation makes this possibility unlikely. Hence, the results, while indicating the unlikelihood of this possibility, do not rule it out entirely. Other studies, however, do tend to rule out this possibility. Rychlak and Nguyen (1979) had subjects in a similar experiment rate the trigrams for familiarity or "wordlikeness", and demonstrated the independence of the like/dislike difference from such an explanation.

There is also precedent for increasing reliance on liked materials. In an experiment involving classroom learning, Slife and Rychlak (1981) found that students who had the most difficulty with the course, relied most on their liked course topics for whatever learning occurred. This finding was also shown to be independent of the amount of time spent studying the individual course topics.

Let us turn again to the independence of logical relation from rehearsal in this experiment. Obviously, in one sense, rehearsal was a significant factor in the learning of even the "related" items across tasks (i.e., less liked items were retained in the more difficult tasks), and many unrelated (disliked) items were retained. Logical learning theory would argue that such effects are indirect in that frequency of exposure allows logical relation to occur. Tulving (1966) entertained a similar notion when discussing "subjective organization." In practice, no concept or meaning is totally related or unrelated to cognitive structure. The related parts are learned in one trial because they are, in a sense, identical to cognitive organization (see principle of tautology, Rychlak, 1977, p. 277-282). The unrelated parts require another exposure (or more) until a relatable cognitive structure is found.

The good students, in the Slife and Rychlak (1980) study described above, were those who learned significantly more disliked materials than the poor students in order to "hold" items until they are made relatable (Reid & Hresko, 1981). The disliked items in this study were learned in a similar manner (viz., through rehearsal and "relatable" parts). The logic of the present study, however, argues against frequency of exposure being even a partial explanation of the learning of all new materials. The extension of the findings to a hypothetical zero level of rehearsal would result in the learning of liked items only (and these would be learned without the benefit of more previous experience).

These results require replication and further corroboration, but a thorough-going framework for learning which is independent of time is provocative. Fully corroborated findings could call into question many axioms of learning used in many models such as information processing. A logical relation explanation would be more akin to a depth of processing and elaborative rehearsal approach. However, even these models appear to ultimately rely on chronological constructs. The cognitive organization (level of processing or elaboration) which governs meaningfulness is itself built up over time (e.g., Craik & Lockhart, 1972, p. 675-676). Hence, logical relation appears to be a relatively unique explanatory principle. Given present results, it seems a principle worthy of further theoretical and empirical study.

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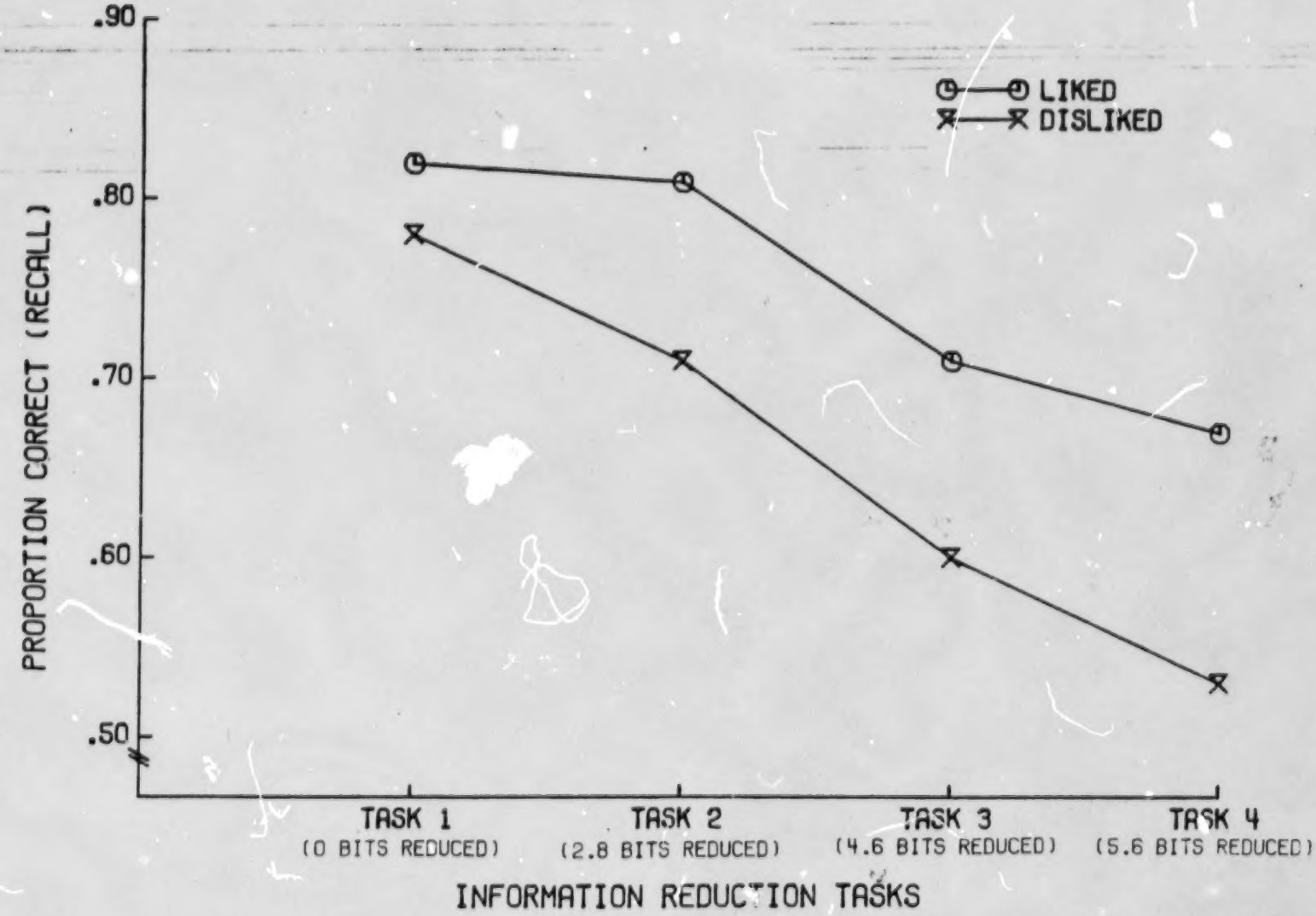
Figure Caption

Figure 1. Mean proportion of recall for items rated liked and items rated disliked across four information reduction tasks.


.90
.80
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PROPORTION CORRECT (RECALL)
LIKED
DISLIKED
TASK 1
(0 BITS REDUCED)
TASK 2
(2.8 BITS REDUCED)
TASK 3
(4.6 BITS REDUCED)
TASK 4
(5.6 BITS REDUCED)
INFORMATION REDUCTION TASKS